OFFICE OF NAVAL RESEARCH

QUARTERLY REPORT

for

1 January 1990 through 31 March 1990

GRANT No. : N00014-89-J-1754

THE EFFECTS OF MAGNETIC STORM PHASES ON F-LAYER IRREGULARITIES FROM AURORAL TO EQUATORIAL LATITUDES

Jules Aarons and Michael Mendillo, Co-Principal Investigators

BOSTON UNIVERSITY
Center for Space Physics
Boston, MA 02215

WORK IN PROGRESS

During the period March 7-18, 1989 using all sky optical observations routinely made at Millstone Hill, we made an interesting set of observations. This period included the sensational March 13-March 14 auroras which were observed visually as far south as Mexico. The optical data has been reduced. The concentration of our study will be on two areas. One is the period of the unusual magnetic storms of March 13 and 14th; the second area of study will be the SAR arc and aurora data of March 7-9. In some ways the latter period of March 7-9 is of more interest since Millstone Hill Incoherent Scatter Radar took continuous data in the mode they felt was most indicative of ionospheric parameter dynamics. We have analyzed scintillation data from both the local site of Sagamore Hill, MA which is operated by the Air Weather Service and from Ramey Air Force Base in Puerto Rico; the effects of the penetration of the electric field equatorwards was such on March 13th that to the south of Puerto Rico there was "auroral fading" on radio transmissions from satellites.

Mendillo has been asked to give a seminar on coordinated ionospheric measurements to the group at Millstone Hill. Included will be the SAR arc observations taken during the March period.

CONTINUING STUDIES

A paper for the Ionospheric Effects Symposium was completed and will be included in the preprints. The abstract of that paper forms the last section of this report.

In progress is a major study of the effect of the ring current on the sub-auroral and equatorial generation of patches of irregularities. For the first time (except for showing a small data set for the 1987 IES) simultaneous observations of high and equatorial latitudes will be utilized.

Reduction of the August 1988 equatorial data is proceeding with the recent receipt of data from the San Marco satellite.

PUBLICATIONS AND PRESENTATIONS

It is expected that the following invited review paper will appear shortly in the Proceedings of the IEEE in 1990

Goodman, J. and J. Aarons (1990) Ionospheric effects on modern electronic systems

ABSTRACT OF IONOSPHRIC EFFECTS SYMPOSIUM PAPER

FORECASTING MORPHOLOGY AND DYNAMICS OF F-LAYER IRREGULARITIES

Jules Aarons
Center for Space Physics
Boston University
725 Commonweath Ave
Boston, MA 02215

ABSTRACT

Data and analyses are at hand to forecast the morphology and dynamics of global F-layer irregularities. For the planners of systems which are impaired by the scattering characteristics of F-layer irregularities, forecasting the morphology allows them to evaluate the utility of operating systems and to plan means for integrating back-ups. For the active users forecasting the dynamics of changes in intensity and characteristics of the irregularities as a function of geophysical conditions allows for warning operators about impending problems.

For the polar region the morphological parameter used as the principal forcing function for intensification of F-layer irregularities is the solar flux. Intense irregularities appear during high sunspot number years. For the auroral region the parameter used as forcing function is magnetic activity as shown by studies of radio stars, low altitude satellites and synchronous satellites. Increased solar flux plays a role both pushing the F-layer irregularity region equatorwards in latitude and increasing the quiet day intensity. For the sub-auroral region the magnetic activity during the injection phase of the magnetic storm plays a leading role. During the recovery phase of the magnetic storm the effect of the decay of ring current ions on the sub-auroral region is such that irregularities are formed of low intensity without auroral or magnetic activity.

For the equatorial region the effect of solar flux is prominent. With high solar flux the plume regions show greater intensity and greater height. With high solar flux the anomaly regions at the edges of the equatorial zone show high electron densities at sunset hours before and during the appearance of irregularities. When irregularities appear intense microwave scintillations are observed during the pre-midnight time period. During years of low solar flux the anomaly region fails to show such levels. Studies with synchronous satellites and with optical observations have allowed the morphology and nature of the iregularities in this region to be clearly understood. Another "forcing function" to be noted is the importance of the month of the year at various longitudes with a lowering of irregularity occurrence and intensity during December and January in the Pacific sector and a lowering of these levels in June, July and August in the 0-75* West sector.